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(54) Elastic-electrically conductive components and radio antennas incorporating such components

(57) An electrically conductive and elastic cord has a central core 12 made up of lengths of a synthetic polymer elastane. This is covered by a braided multi filament polyester yarn 16. Over this is positioned an electrically conductive braid 18 of copper or cadmium copper tinsel wire. An outer layer 20 may be similar to the layer 16. The use of the synthetic polymer elastane gives superior properties to natural rubber, and the braid allows the conductor to be stretched. The cord 10 may be used as an elastic conductive inner component in a self-erecting whip antenna, which has individual tubular elements 30 of metal or non-conductive material. The arrangement is such that to de-erect the antenna the cord is stretched and the elements 30 are folded alongside each other.

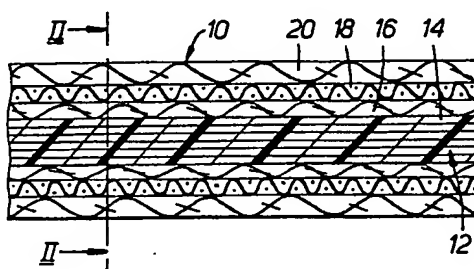


FIG. 1.

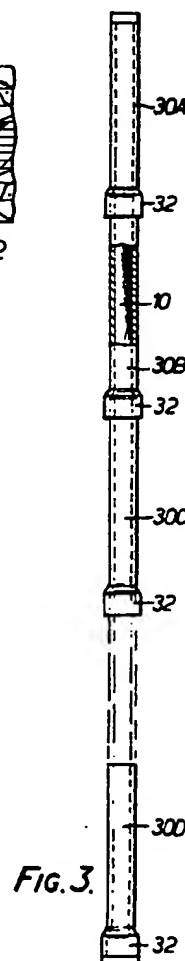


FIG. 3.

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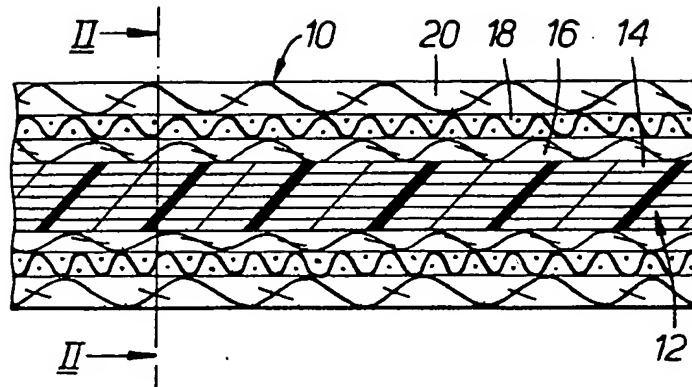


FIG. 1.

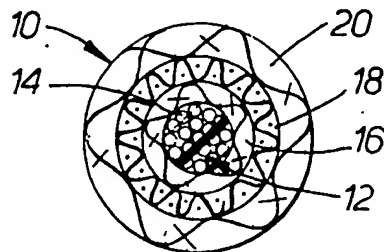


FIG. 2.

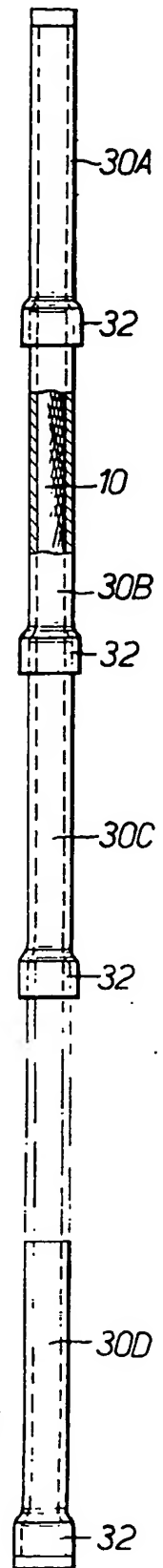


FIG. 3.

SPECIFICATION

Elastic electrically conductive components and radio antennas incorporating such components

The invention relates to elastic, electrically conductive components and to radio antennas incorporating such components.

10 According to the invention, there is provided an elastic and electrically conductive component, comprising elongate elastic material and electrically conductive material in the form of a braid.

15 According to the invention, there is further provided an electrically conductive and elastic cord, comprising a core made of synthetic elastic material covered by a layer of braided multi filament yarn which in turn is covered by braided electrically conductive wire, the latter being covered by braided multi filament textile yarn.

According to the invention, there is also provided a radio antenna, comprising a plurality of relatively stiff individual elements having means for interlocking them together in end-to-end relationship to form a continuous elongate structure, and a continuous elastic and electrically conductive flexible cord which runs for the full length of the elongate structure and is attached to the elements at each end of the said structure so as to be under tension and thus to assist in holding the structure in erect form, but permitting the structure to be de-erected by stretching the cord and releasing the interlock between adjacent elements.

According to the invention, there is still further provided a self-erecting whip antenna, comprising a plurality of hollow tubular elements made of nonelectrically conducting and relatively stiff material each having one end which is enlarged to receive the other end of an adjacent element so as to provide an erect elongate structure in which all the elements are interlocked end-to-end, and an elastic and electrically conductive cord passing continuously along and within the tubular elements and attached to the endmost elements of the said structure so as to be under tension and thereby assist in holding the structure in the erect condition, but permitting the structure to be de-erected by temporarily stretching the cord so as to allow each element to be moved endwise with respect to the adjacent element thereby releasing the interlocks between adjacent elements, the cord comprising a core of synthetic elastic material outside which is arranged a braid of electrically conductive wire which in turn is covered with a protective layer of textile material.

A longitudinal elastic and electrically conductive component embodying the invention, and a radio antenna embodying the invention, will now be described, by way of example only, with reference to the accompanying diagrams

grammatic drawings in which:

Figure 1 is a longitudinal cross-section through the component;

Figure 2 is a cross-section on the line II-II of Figure 1; and

Figure 3 is a cross-section through part of the radio antenna.

The component illustrated in Figures 1 and 2 is in the form of a flexible elongate cord indicated generally at 10 which is both elastic (primarily in a longitudinal direction) and also electrically conductive.

The component 10 has a central core 12 which is made up of individual strands 14 of elastic material. The material of the strands 14 may, for example, be synthetic material such as a synthetic polymer elastane of the segmented polyether urethane or polyester polyurea urethane type. However, other suitable materials may be used instead. The strands 14 may be twisted together.

The core 12 is surrounded by a layer 16 such as made of braided multi-filament polyester yarn. This in turn is covered by an electrically conductive layer 18. The layer 18 may be made of copper or cadmium copper wires. Advantageously, the layer 18 is in the form of a braid of cadmium copper tinsel wires. The wires themselves may be wound over polyester filaments.

Finally, an outer layer 20 of braided multi-filament polyester yarn is provided.

The resultant cord 10 has excellent elastic properties because of the use of the synthetic elastic material for the core 12. The elastic power exerted by the synthetic polymer elastane is about three times that of natural rubber. This enables the whole cord to be of smaller diameter, for a given elastic strength, than would be the case if natural rubber were used. The synthetic elastic material also has the advantage that it is much more resistant to degradation by sunlight and to photo-oxidative degradation than is natural rubber and is less affected by other radiation sources. The synthetic material is relatively unaffected by the presence of mineral oils and its storage life, both in the stretched and in the relaxed condition, is considerably superior to that of natural rubber. Unlike natural rubber, its strength remains unaffected in contact with copper.

The braided construction of the layers 16, 18 and 20 enables them to accommodate repeated stretching and relaxing, and flexing, with the filaments of the braids easily altering their alignment relative to each other to accommodate changes in length. The braided construction also ensures that the electrical conductivity of the layer 18 remains relatively unaffected by stretching.

The use of cadmium copper wire gives good flexibility and an abrasion resistance which is many times better than that of soft

The multi-filament polyester layer 20 gives good overall protection and a higher abrasion resistance than monofilament material. Instead of polyester yarn, nylon yarn may be used.

The cord illustrated in Figures 1 and 2 may be used for any suitable purpose where an elastic component having good mechanical properties and which is also a good electrical conductor is required.

Figure 3 shows one suitable application.

Figure 3 illustrates part of a self-erecting whip antenna. The antenna is made up of a plurality of separate, and relatively short, stiff tubular elements, only some of which are shown at 30A, 30B, 30C, 30D. The elements are arranged to interlock longitudinally in a suitable way. As illustrated, each element 30 has one of its ends enlarged as at 32 so as to accommodate the opposite end of the next element 30. Although the drawings show the lower end of each element being enlarged, it will be appreciated that the upper end could be enlarged instead. Alternatively either the upper or lower end of each element may be reduced so that it will fit into the end of the next element 30. In order to hold the resultant multi-element structure together, an elastic cord 10, of the form described above with reference to Figures 1 and 2, runs centrally within the tubular elements and is firmly fixed to the topmost element 30A and to the base element 30D. The length of the cord in relation to the total length of the interlocked elements 30 is such that the cord 10 is in tension and all the elements 30 are held in interlocked relationship, thus rendering the structure relatively rigid. One end of the cord is electrically connected to a suitable connector by means of which a signal may be passed to or from the antenna.

Nevertheless, however, the structure may be easily folded up simply by grasping adjacent elements and pulling them apart (so as to stretch the cord 10). Thus this releases the mechanical interlock between the elements and allows them to be placed alongside each other. This process is repeated for the other elements until the whole structure is in a folded position with all the elements side by side and adjacent each other, in which position it may be held by means of a suitable band or clamp. It can easily be re-erected simply by removing the band or clamp, grasping the base element 30D, and shaking the elements so as to permit the elasticity in the stretched cord 10 to pull all the elements into the end-to-end interlocking relationship illustrated in Figure 3.

Such a structure forms an excellent foldable and self-erecting whip antenna, the required electrical conductivity being provided by the conductive braid 18 of the cord 10. The elements 30 do not therefore have to be electrically conductive themselves, and the

resultant structure is advantageous as compared with whip antennas which attain their electrical conductivity by using elements 30 made of electrically conductive material (and with a non-electrically conductive elastic cord). Such structures suffer from the disadvantage that the required continuous electrical conductivity depends on effective electrical contact being maintained at each joint between adjacent elements 30. Furthermore, manufacture of suitable metal tubular elements is relatively difficult and expensive. In contrast, the elements 30 in the structure described with reference to Figure 3 can be made of a variety of suitable materials. For example, they may be made of glass fibre or plastics material (though they may be made of metal if desired).

The properties of the cord 10 are particularly advantageous for use in the whip antenna shown in Figure 3. The braided conductive layer 18 is highly resistant to mechanical failure which might be caused by the repeated flexing which it undergoes during erection and collapsing of the antenna. It will be appreciated that, when the antenna is in its fully folded state, the cord 10 is necessarily stretched over and in contact with the ends of the elements 30. The strong external layer 20 protects the cord from abrasion by the ends of the tubular elements.

However, although the cord 10 is particularly suitable for use in the antenna of Figure 3, any other suitable elastic cord which is also electrically conductive may be used instead.

CLAIMS

1. An elastic and electrically conductive component, comprising elongate elastic material and electrically conductive material in the form of a braid.
2. A component according to claim 1, in which the elastic material forms the core of the component and is covered by the braid.
3. A component according to claim 1 or 2, in which the elastic material is synthetic material such as a synthetic polymer elastane.
4. A component according to claim 3, in which the synthetic polymer elastane is of the segmented polyether urethane or polyester polyurea urethane type.
5. A component according to any preceding claim, having an outer covering of a multi-filament yarn.
6. A component according to claim 5, in which the outer covering is a braid of continuous multi-filament polyester or nylon textile yarn.
7. An electrically conductive and elastic cord, comprising a core made of synthetic elastic material covered by a layer of braided multi-filament yarn which in turn is covered by braided electrically conductive wire, the latter being covered by braided multi-filament textile yarn.

8. A component according to claim 7, in which the synthetic elastic material comprises individual filaments of a synthetic polymer elastane.

- 5 9. A radio antenna, comprising a plurality of relatively stiff individual elements having means for interlocking them together in end-to-end relationship to form, when thus erected, a continuous elongate structure, and
10 a continuous elastic and electrically conductive flexible cord which runs along the length of the elongate structure and is attached to the elements at each end of the said structure so as to be under tension and thus to assist in
15 holding the structure in erect form, but permitting the structure to be de-erected by stretching the cord and releasing the interlock between adjacent elements.

- 20 10. An antenna according to claim 9, in which the elements are of hollow tubular form and the cord runs within them.

11. An antenna according to claim 9 or 10, in which the tubular elements are made of non-electrically conductive material such as
25 glass fibre or plastics material.

12. An antenna according to any one of claims 9 to 11, in which one end, only, of each element is sized so as to receive or be received in the other end of the next adjacent
30 element in a relatively tight fit, thereby interlocking them.

13. An antenna according to any one of claims 9 to 12, in which the elastic cord comprises a component according to any one
35 of claims 1 to 8.

14. A self-erecting whip antenna, comprising a plurality of hollow tubular elements made of nonelectrically conducting and relatively stiff material each having one end which
40 is enlarged to receive the other end of an adjacent element so as to provide an erect elongate structure in which all the elements are interlocked end-to-end, and an elastic and electrically conductive cord passing continuously along and within the tubular elements and attached to the endmost elements of the said structure so as to be under tension and thereby assist in holding the structure in the erect condition, but permitting the structure to
45 be de-erected by temporarily stretching the cord so as to allow each element to be moved endwise with respect to the adjacent element thereby releasing the interlocks between adjacent elements, the cord comprising a core of
50 synthetic elastic material outside which is arranged a braid of electrically conductive wire which in turn is covered with a protective layer of textile material.

15. An antenna according to claim 14, in which the synthetic elastic material is a synthetic polymer elastane of the segmented polyether urethane or polyester polyurea urethane type.

16. An antenna according to claim 13 or
65 14, in which the outer covering is a braid of

continuous multifilament yarn, and a similar braid is positioned immediately around the core.

17. An elastic and electrically conductive elongate component, substantially as described with reference to Figures 1 and 2 of the accompanying drawings.

18. A self-erecting whip antenna, substantially as described with reference to Figure 3
75 of the accompanying drawings.

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